PATENT ABSTRACTS OF JAPAN

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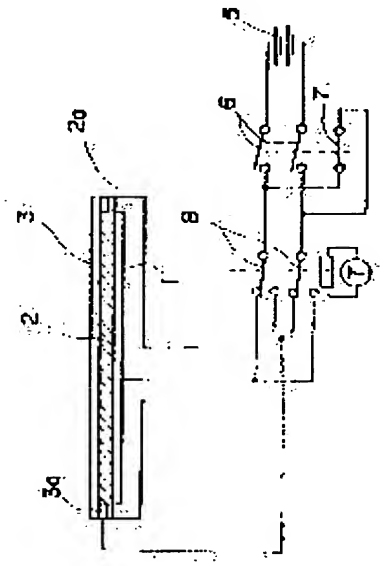
(54) ELECTROSTATIC ATTRACTING DEVICE

(57)Abstract:
PURPOSE: To enable attracting force to be stabilized, by providing a switch applying power supply voltage and disconnecting it, a switch short-circuiting paired electrodes, when the power supply voltage is disconnected, and a switch inverting polarity of the applied voltage during attraction.
CONSTITUTION: An attracted material 3 is placed on an insulating material 2, and the first switch 6 is turned on. Then voltage is applied to an electrode 1 and the attracted material 3 from a DC power supply 5. Here the second switch 7 is left as turned off. After a fixed length of time, determined by the applied voltage and the kind of the insulating material, the third switch 8 operates inverting polarity of the voltage applied to the electrode 1 and the attracted material 3. Thereafter, the polarity of the applied voltage is inverted by the third switch 8 in every fixed time. When the attracted material 3 is desired to be removed, attracting force is reduced by short-circuiting the electrode 1 and the attracted material 3 through the second switch 7 interlocking to the first switch 6 if it is turned off.



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JAPANESE [JP,07-004718,B]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The insulating layer which has the installation side in which the adsorbate-ed is laid, and the electrode which makes the pair which makes the installation side of said insulating layer generate polarization charge, The DC power supply which generate the electrical potential difference impressed to said electrode, and the 1st switching means switched in order to impress the electrical potential difference from said DC power supply to said electrode, The electrostatic adsorber characterized by having the 2nd switching means switched in order to reverse the polarity of said applied voltage once [at least] or more while said 1st switching means has cut and replaced the electrical-potential-difference impression side.
[Claim 2] Said 2nd switching means is an electrostatic adsorber given in the 1st term of a patent claim characterized by having the timer switch switched for every predetermined time.
[Claim 3] The electrostatic adsorber given in the 1st term of a patent claim characterized by one side of said electrode touching said adsorbate-ed when said adsorbate-ed is laid on the installation side of said insulating layer.
[Claim 4] Each of said electrode is an electrostatic adsorber given in the 1st term of a patent claim characterized by meeting said adsorbate-ed in respect of installation of said insulating layer, and the opposite side, and being arranged.
[Claim 5] The electrostatic adsorber given in the 1st term of a patent claim characterized by said insulating layer being the thermal-spraying film of an aluminum oxide.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
This invention relates to the electrostatic adsorber which decreased the residual adsorption force at the time of raising the repeatability of adsorption power and carrying out attach/detach of the adsorbate-ed by reversing an applied-voltage polarity during adsorption of the adsorbate-ed especially about the electrostatic adsorber which holds conductive matter, such as a semi-conductor wafer, in a vacuum.
[Description of the Prior Art]
In recent years, dry-ization progresses quickly and processing a sample in the vacuum of 10 or less torrs is increasing the semi-conductor manufacture process with an etching system, an ashing device, ion implantation equipment, plasma-CVD equipment, electron beam lithography, and X ray lithography.
Although many mechanical chucks, vacuum chucks, etc. according [maintenance of a sample] to the mechanical approach had been used conventionally, the mechanical chuck had the fault that there was a possibility of the whole sample not being uniformly held to a holder, and doing damage to a sample. Moreover, since a vacuum chuck uses differential pressure with atmospheric air, it is impossible to use it within the vacuum chamber of the above-mentioned dry process equipment.
Furthermore, in an ion beam etching system, a magnetron reactive ion etching system, and ion implantation equipment, since it is exposed to a fast ion, temperature rises, and a sample does heat damage to a resist etc. Moreover, in a CVD system, a sample needs to carry out the temperature control of a sample in many cases, such as the generation rate of the generation film, and strong against a property being influenced with temperature.
Therefore, the electrostatic adsorption using the electrostatic force which can take the uniform thermal contact to a sample and a holder in a vacuum is very advantageous.
Fig. 3 shows the principle of this electrostatic adsorption. As for the adsorbate-ed which an electrode becomes in 1 and an insulating material and 3 become from the conductive matter in 2, and 4, in this drawing, a switch and 5 are DC power supplies.
if the adsorbate 3-ed is installed through an insulating material 2 on an electrode 1, it switches on [4] in the above-mentioned configuration and an electrical potential difference is impressed according to a power source 5 between an electrode 1 and the adsorbate 3-ed -- between an electrode 1 and the adsorbate 3-ed -- F(N) =1/2 and epsilonoepsilons(V/d)2S -- adsorption power occurs. Here, for the dielectric constant in a vacuum, and epsilons, the specific inductive capacity of an insulating material 2 and V are [epsilono / the thickness of an insulating material 2 and S of the electrical potential difference of a power source 5 and d] the area of an electrode 1.
However, in the conventional electrostatic adsorber, when the adsorbate 3-ed is adsorbed, even if it turns off a switch 4, a charge will remain in an insulating material 2, and adsorption power will remain for a long time. Moreover, there were problems, like there is dispersion also in the time amount to which adsorption power decreases.
In the equipment of Fig. 3 , after actually turning off a switch 4, time amount until adsorption

power decreases to 1 g/cm2 was measured. The insulating material 2 at this time is the aluminum2O3 thermal-spraying film of thickness 50 micro/m.

印加電圧	1000V	1500V
所要時間		
1回目	110秒	620秒
2回目	120秒	420秒
3回目	100秒	720秒

It cuts in above very long time amount.

[Objects of the Invention]

This invention was made in view of the trouble of the above-mentioned conventional example, makes it possible to decrease the residual adsorption force in an electrostatic adsorber promptly, and aims at enabling it to perform attachment-and-detachment actuation of the adsorbate-ed promptly.

[Summary of the Invention]

In order to attain this purpose the electrostatic adsorber of this invention The insulating layer which has the installation side in which the adsorbate-ed is laid, and the electrode which makes the pair which makes the installation side of said insulating layer generate polarization charge, The DC power supply which generate the electrical potential difference impressed to said electrode, and the 1st switching means switched in order to impress the electrical potential difference from said DC power supply to said electrode, It has the 2nd switching means switched in order to reverse the polarity of said applied voltage once [at least] or more while said 1st switching means is switched to the electrical-potential-difference impression side.

Since according to this the polarity of applied voltage is reversed once [at least] or more by the 2nd switching means while the 1st switching means is switched to the electrical-potential-difference impression side, the residual adsorption force (residual charge) in which after cutoff of the applied voltage to an electrode remains between an insulating layer and the adsorbate-ed is reduced, and the adsorbate-ed is detached and attached promptly. Moreover, destabilization of the adsorption power at the time of the adsorption on and after the next time by residual charge is also avoided. Furthermore, since adsorption power does not continue increasing during adsorption of the adsorbate-ed, also when adsorbing the adsorbate-ed for a long time, there is also no possibility that the adsorbate-ed, an insulating layer, etc. may be destroyed by the adsorption power.

[Example]

Hereafter, the example of this invention is explained, referring to a drawing. In addition, it expresses with the sign same about corresponding components identically to the conventional example.

Fig. 1 shows the important section configuration of the electrostatic adsorber concerning one example of this invention. In this drawing, 2a is a chuck body for supporting a wafer, and as shown in drawing, it builds in the insulating material 2 and the electrode 1. When a wafer 3 is laid, there is electrode 3a installed so that a wafer 3 might be touched in the upper part of an insulating material 2, and the up periphery of chuck body 2a. Therefore, the potential with always same electrode 3a and a wafer 3 is maintained at the time of wafer 3 installation. That is, DC power supply 5 are in this example to impress an electrical potential difference to an electrode 1 and the direct wafer 3. 6 is the 1st switch and turns applied voltage on and off. 7 is an auxiliary switch and is being interlocked with the 1st switch 6, and when the 1st switch 6 is ON (close), the auxiliary switch 7 serves as OFF (off), and when the 1st switch 6 is off, the auxiliary switch 7 serves as ON. 8 is the 2nd switch and is an electrode 1 and a timer switch which reverses the electrical-potential-difference polarity between the adsorbate 3-ed for every fixed time amount. In the above-mentioned configuration, the wafer which is the adsorbate 3-ed is placed on an insulating material 2, and the 1st switch 6 is turned ON. Then, an electrical potential difference is impressed to an electrode 1 and a wafer 3 from DC power supply 5. Under the present

circumstances, the auxiliary switch 7 is turned OFF. If fixed time amount decided by the class of applied voltage and insulating material is formed, the polarity of the electrical potential difference which the 2nd switch 8 operates and is impressed to an electrode 1 and a wafer 3 will be reversed. Henceforth, the polarity of applied voltage is reversed by the 2nd switch 8 for every fixed time amount.
If the 1st switch 6 is turned OFF to remove a wafer 3, a wafer 3 will connect with an electrode 1 too hastily with the switch 7 of the assistance currently interlocked with the 1st switch 6, and adsorption power will decrease.
After the following table was obtained as a result of experimenting in this example, and it turns off a switch 6, it shows electrical-potential-difference polarity-reversals time amount [min required / for every applied voltage when making time amount until adsorption power serves as zero substantially into 1 second].

電極印加電圧	500V	1000V	1500V
反転時間	60秒	30秒	15秒

It is a thing at the time of 50 micrometers in thickness by the plasma metal spray film of aluminum 2O3 as the thing of Fig. 3 with the dielectric 2 of an electrostatic adsorber same [the above value].
During adsorption, although adsorption power decreases for a moment at the time of electrical-potential-difference polarity reversals, adsorption power returns within 1 second about.
Fig. 2 shows the important section configuration of the electrostatic adsorber concerning other examples of this invention. The equipment of this drawing arranges the electrodes 1a and 1b of a pair to an installation side and the field of the opposite side to both the insulating materials 2, and he is trying to impress an electrical potential difference to these electrodes 1a and 1b to the equipment of Fig. 1 . The operation is completely the same as that of the case of the equipment of Fig. 1 mentioned above.
"when the conventional electrostatic adsorber is used, in order that [moreover,] the repeatability of adsorption power may be very bad and may solve this problem with the residual charge of an insulating material 2 -- whenever it adsorbs the adsorbate-ed once, an applied-voltage polarity is reversed" -- things are proposed (JP,58-114437,A). However, although stabilization of adsorption power was obtained by this approach, it was difficult to decrease adsorption power at the time of arbitration, and to remove the adsorbate-ed promptly.
In this example, since the polarity of applied voltage is reversed with the predetermined time interval while adsorbing the adsorbate-ed, repeatability high also about this adsorption power can be acquired.
In addition, although the thermal-spraying film of an aluminum oxide was used as an insulating material in the example mentioned above, this invention is not limited to this and can use other ****.

[Effect of the Invention]

As explained above, according to this invention, by reversing an applied-voltage polarity during adsorption of the adsorbate-ed, desorption of the adsorbate-ed can be performed promptly and, moreover, stabilization of adsorption power can be obtained.

[Translation done.]

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(56)参考文献　特開　昭59－127847（ＪＰ，Ａ）
特公　昭61－4611（ＪＰ，Ｂ２）

(54)【発明の名称】　静電吸着装置

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【特許請求の範囲】

【請求項１】被吸着物が載置される載置面を有する絶縁層と、前記絶縁層の載置面に分極電荷を発生させる対をなす電極と、前記電極に印加される電圧を発生する直流電源と、前記直流電源からの電圧を前記電極へ印加するために切り換えられる第１スイッチ手段と、前記第１スイッチ手段が電圧印加側に切り換られている間に前記印加電圧の極性を少なくとも１回以上反転させるために切り換えられる第２スイッチ手段を有することを特徴とする静電吸着装置。

【請求項２】前記第２スイッチ手段は所定時間毎に切り換えられるタイマスイッチを有することを特徴とする特許請求の範囲第１項記載の静電吸着装置。

【請求項３】前記絶縁層の載置面上に前記被吸着物が載置された際、前記電極の一方が前記被吸着物に接することを特徴とする特許請求の範囲第１項記載の静電吸着装置。

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【請求項４】前記電極のそれぞれは前記絶縁層の載置面と反対側の面で前記被吸着物に対面して配置されていることを特徴とする特許請求の範囲第１項記載の静電吸着装置。

【請求項５】前記絶縁層が酸化アルミニウムの溶射膜であることを特徴とする特許請求の範囲第１項記載の静電吸着装置。

【発明の詳細な説明】

［発明の属する分野］

本発明は、半導体ウエハ等の導電性物質を真空中で保持する静電吸着装置に関し、特に被吸着物の吸着中に印加電圧極性を反転することにより吸着力の再現性を向上させ、かつ被吸着物を装脱する際の残留吸着力を減少させ

た静電吸着装置に関する。

［従来の技術］

近年、半導体製造プロセスはドライ化が急速に進み、エッチング装置、アッシング装置、イオン注入装置、プラズマCVD装置、電子ビームリソグラフィー、X線リソグラフィー等では試料を10torr以下の真空中で処理する事が増加している。

従来、試料の保持は機械的方法によるメカニカルチャックや真空チャック等が多く用いられてきたが、メカニカルチャックは試料全体をホルダに一様に保持することができず、また試料に損傷を与えるおそれがあるという欠点があった。また、真空チャックは大気との圧力差を利用するため上記ドライプロセス装置の真空チャンバー内で使用することは不可能である。

さらに、イオンビームエッチング装置、マグネトロン反応性イオンエッチング装置、イオン注入装置では、試料は高速イオンにさらされるため温度が上昇し、レジスト等に熱損傷を与える。また、CVD装置では試料が温度によって生成膜の生成速度や、性質に強い影響を受ける等、試料の温度調整をする必要があることが多い。

従って真空中で試料とホルダとの一様な熱的コンタクトをとることができる静電力を利用した静電吸着は非常に有利である。

第３図は、この静電吸着の原理を示す。同図において、１は電極、２は絶縁物、３は導電性物質からなる被吸着物、４はスイッチ、５は直流電源である。

上記構成において、電極１上に絶縁物２を介して被吸着物３を設置し、スイッチ４を投入して電極１と被吸着物３の間に電源５により電圧を印加すると、電極１と被吸着物３の間に

$F(_N) = 1/2 \cdot \varepsilon_o \varepsilon_s (V/d)^2 S$

なる吸着力が発生する。ここで、ε_oは真空中の誘電率、ε_sは絶縁物２の比誘電率、Ｖは電源５の電圧、ｄは絶縁物２の厚さ、そしてＳは電極１の面積である。

しかし、従来の静電吸着装置では、被吸着物３を吸着した場合、スイッチ４を切っても絶縁物２に電荷が残り、吸着力が長時間残ってしまう。また、吸着力が減少する時間にもばらつきがある等の問題があった。

第３図の装置において、実際にスイッチ４を切った後、吸着力が1g/cm²に減少するまでの時間を測定した。この時の絶縁物２は厚さ50μ/mのAl_2O_3溶射膜である。

印加電圧	1000V	1500V
所要時間		
1回目	110秒	620秒
2回目	120秒	420秒
3回目	100秒	720秒

以上のように非常に長い時間かかる。

［発明の目的］

本発明は、上述従来例の問題点に鑑みてなされたもので、静電吸着装置における残留吸着力を速やかに減少させることを可能にし、被吸着物の着脱動作を速やかに行なえるようにすることを目的とする。

［発明の概要］

この目的を達成するため本発明の静電吸着装置は、被吸着物が載置される載置面を有する絶縁層と、前記絶縁層の載置面に分極電荷を発生させる対をなす電極と、前記電極に印加される電圧を発生する直流電源と、前記直流電源からの電圧を前記電極へ印加するために切り換えられる第１スイッチ手段と、前記第１スイッチ手段が電圧印加側に切り換えられている間に前記印加電圧の極性を少なくとも１回以上反転させるために切り換えられる第２スイッチ手段を有する。

これによれば、第１スイッチ手段が電圧印加側に切り換えられている間に、第２スイッチ手段により印加電圧の極性が少なくとも１回以上反転されるため、電極への印加電圧の遮断後も絶縁層と被吸着物の間に残存する残留吸着力（残留電荷）が低減され、被吸着物は速やかに着脱される。また、残留電荷による次回以降の吸着時の吸着力の不安定化も回避される。さらに、被吸着物の吸着中に吸着力が増加し続けることがないので、被吸着物を長時間吸着するような場合にも、その吸着力により被吸着物や絶縁層等が破壊されてしまうおそれもない。

［実施例］

以下、図面を参照しながら、本発明の実施例を説明する。なお、従来例と同一または対応する部品については同一の符号で表す。

第１図は、本発明の一実施例に係る静電吸着装置の要部構成を示す。同図において、2aはウエハを支持する為のチャック本体であり、図のように絶縁物２と電極１を内蔵している。絶縁物２の上部、チャック本体2aの上部外周には、ウエハ３が載置された時にウエハ３と接するように設置された電極3aがある。従って、ウエハ３載置時は電極3aとウエハ３は常に同じ電位を保つ。即ち、本実施例では直流電源５は電極１と直接ウエハ３に電圧を印加することにある。６は第１のスイッチで、印加電圧のオン・オフを行なう。７は補助のスイッチで、第１のスイッチ６と連動しており、第１のスイッチ６がオン（閉路）であるときは、補助のスイッチ７はオフ（開路）となり、第１のスイッチ６がオフであるときは補助のスイッチ７はオンとなる。８は第２のスイッチで、電極１と被吸着物３間の電圧極性を一定時間毎に反転するタイマスイッチである。

上記構成において、絶縁物２の上に被吸着物３であるウエハを置き、第１のスイッチ６をオンにする。すると直流電源５から電極１とウエハ３に電圧が印加される。この際、補助のスイッチ７はオフにされている。印加電圧と絶縁物の種類によって決まった一定時間がたつと第２のスイッチ８が動作して電極１とウエハ３に印加される

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電圧の極性が反転される。以後、一定時間毎に第２のスイッチ８により印加電圧の極性が反転されていく。

ウエハ３を取り外したい時は、第１のスイッチ６をオフにすれば、第１のスイッチ６と連動している補助のスイッチ７により電極１とウエハ３が短絡され吸着力が減少する。

下表は、本実施例において実験を行なった結果得られたもので、スイッチ６をオフした後吸着力が実質的に零となるまでの時間を１秒としたときの各印加電圧ごとの必要最小な電圧極性反転時間を示す。

電極印加電圧	500V	1000V	1500V
反転時間	60秒	30秒	15秒

以上の値は、静電吸着装置の誘電体２が、第３図のものと同様の、Al_2O_3のプラズマ溶射膜で厚さ50μmの時のものである。

吸着中、電圧極性反転時に一瞬吸着力が減少するが、おおよそ１秒以内に吸着力は復帰する。

第２図は、本発明の他の実施例に係る静電吸着装置の要部構成を示す。同図の装置は、第１図の装置に対し、一対の電極1a,1bを共に絶縁物２に対し載置面と反対側の面に配置し、これらの電極1a,1bに電圧を印加するようにしている。その作用は、上述した第１図の装置の場合と全く同様である。

また、従来の静電吸着装置を用いた場合、絶縁物２の残＊

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＊留電荷により吸着力の再現性が非常に悪く、この問題を解決するために、「被吸着物を１回吸着する毎に、印加電圧極性を反転する。」ことが提案されている（特開昭58－114437号）。しかし、この方法では吸着力の安定化は得られるが、任意の時に吸着力を減少させ、速やかに被吸着物を取り外すことは困難であった。

本実施例では、被吸着物を吸着中に所定の時間間隔で印加電圧の極性を反転していくため、この吸着力についても高い再現性を得ることができる。

なお、上述した実施例では絶縁物として酸化アルミニウムの溶射膜を用いたが、本発明はこれに限定されるものではなく、他の縁物も使用することができる。

［発明の効果］

以上説明したように、本発明によれば、被吸着物の吸着中に印加電圧極性を反転することにより、被吸着物の脱着を速やかに行なうことができ、しかも吸着力の安定化を得ることができる。

【図面の簡単な説明】

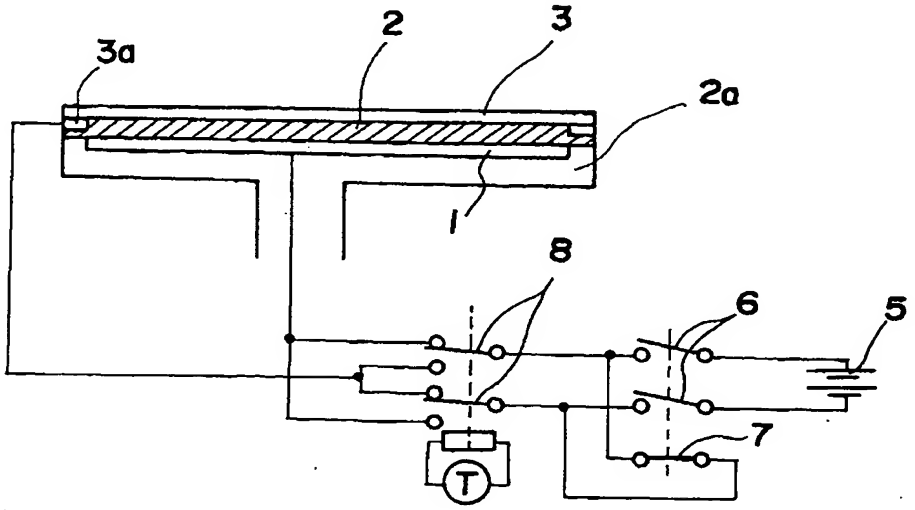
第１図は、本発明の一実施例に係る静電吸着装置の要部構成図、

第２図は、本発明の他の実施例に係る静電吸着装置の要部構成図、

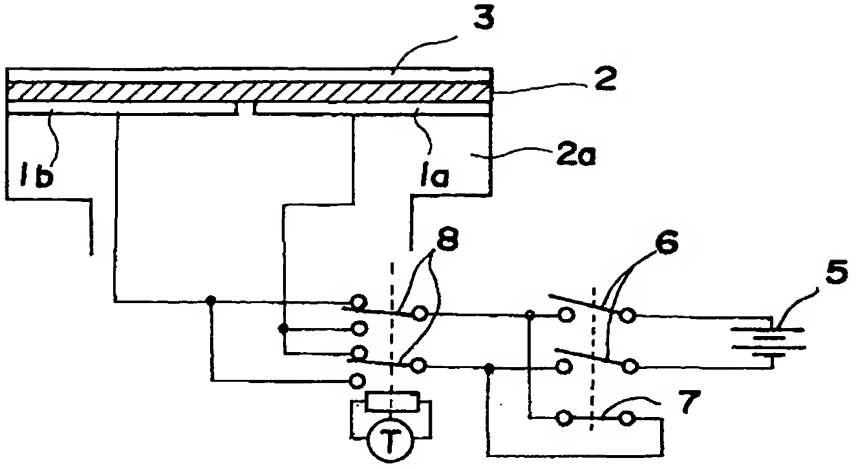
第３図は、従来の静電吸着装置の要部構成図である。

1,1a,1b:電極、2:絶縁物、3:被吸着物、5:直流電源、6:第１のスイッチ、7:補助スイッチ、8:第２のスイッチ。

【第１図】



【第２図】



【第３図】